

COMP 3850 - Assignment 3

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Question 1:

Final Weight Matrix Obtained = $\begin{bmatrix} 0 & 0 & 0 & -2 & 2 & -2 & 0 & 0 & 0 \end{bmatrix}$

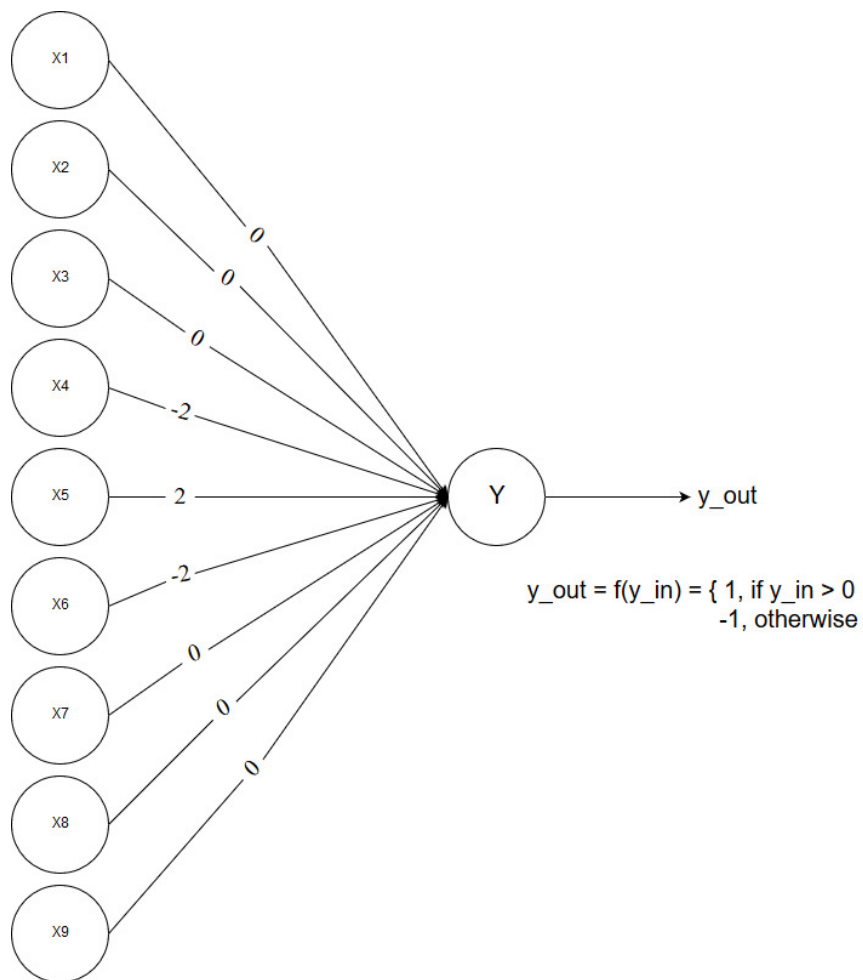
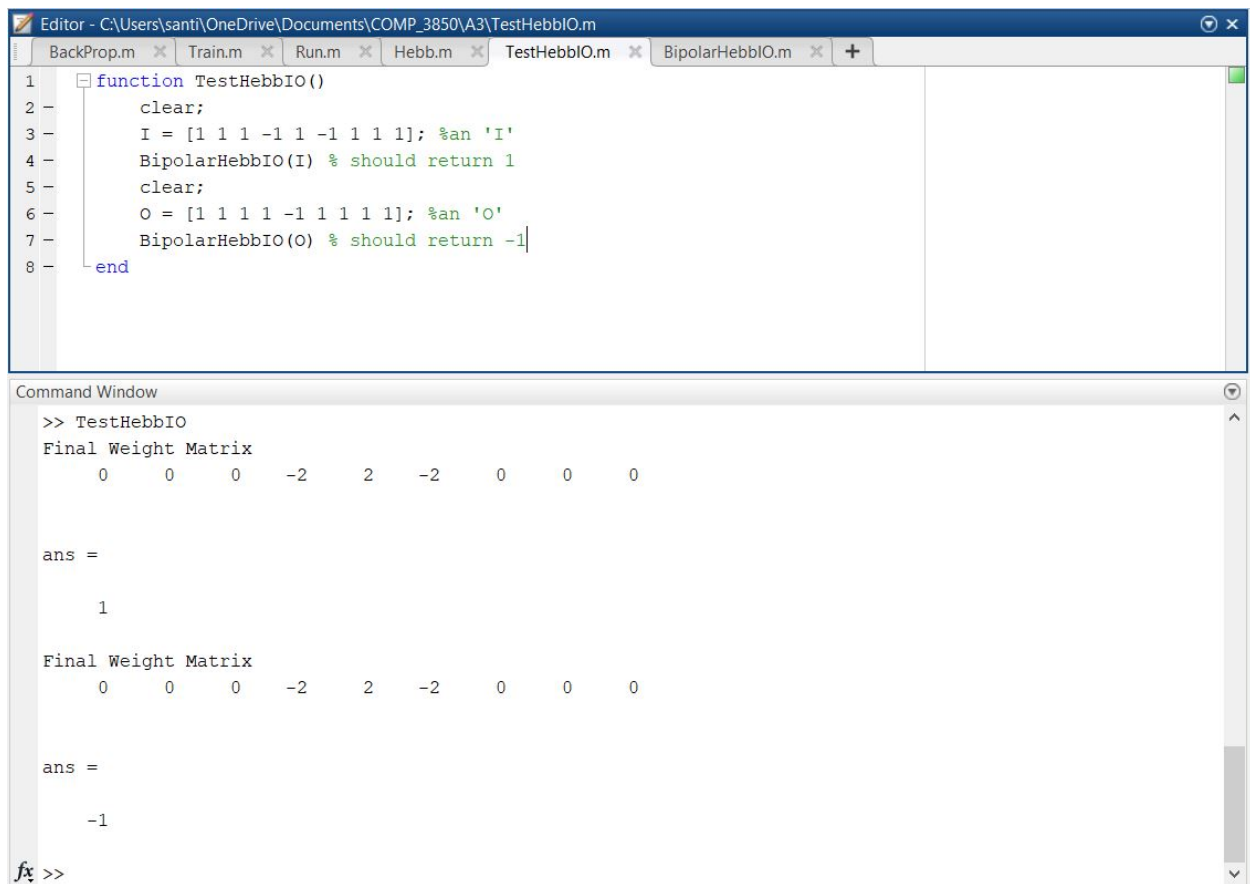


Figure 1: Heb Net for Differentiating Between I and O patterns



The image shows a MATLAB environment with an Editor window and a Command Window. The Editor window contains a function named `TestHebbIO()` that tests the `BipolarHebbIO` function. The function sets up two input vectors, `I` and `O`, and calls `BipolarHebbIO` on each. The Command Window shows the execution of `TestHebbIO`, displaying the final weight matrix and the output for each input vector.

```
Editor - C:\Users\santi\OneDrive\Documents\COMP_3850\A3\TestHebbIO.m
BackProp.m Train.m Run.m Hebb.m TestHebbIO.m BipolarHebbIO.m +

1 function TestHebbIO()
2     clear;
3     I = [1 1 1 -1 1 -1 1 1 1]; %an 'I'
4     BipolarHebbIO(I) % should return 1
5     clear;
6     O = [1 1 1 1 -1 1 1 1 1]; %an 'O'
7     BipolarHebbIO(O) % should return -1
8 end

Command Window
>> TestHebbIO
Final Weight Matrix
    0    0    0   -2    2   -2    0    0    0

ans =
    1

Final Weight Matrix
    0    0    0   -2    2   -2    0    0    0

ans =
   -1

fx >>
```

Figure 2: Snippet of Hebb Net In MATLAB

Question 2:

Input pattern used: $[0, 1]$

Learning Rate, $\alpha = 0.25$

Desired output, $d = 1$

Using Binary Sigmoid as activation function:

$$\phi = \frac{1}{1 + e^{-x}}$$

$$\phi' = \phi(1 - \phi)$$

Forward Pass:

Input layer to middle layer:

$$Z_{1in} = (0)(0.6) + (1)(0.1) + (1)(0.3) = 0.4$$

$$Z_{2in} = (1)(0.4) + (0)(0.3) + (1)(0.5) = 0.9$$

Hidden Layer:

$$Z_{1out} = \frac{1}{1 + e^{-0.2}} = 0.5498339973$$

$$Z_{2out} = \frac{1}{1 + e^{-0.9}} = 0.7109495026$$

Output layer:

$$Y_{in} = (0.5498339973)(0.4) + (0.7109495026)(0.1) = 0.09102854918$$

$$Y_{out} = \frac{1}{1 + e^{-0.09102854918}} = 0.5227414361$$

Backward Pass:

Output Layer:

$$e = d - y = 1 - 0.5227414361 = 0.4772585639$$

$$\delta = 0.5227414361(1 - 0.5227414361)(0.4772585639) = 0.1190678158$$

Hidden Layer:

$$e_{11} = (0.4)(0.1190678158) = 0.04762712632$$

$$\delta_{11} = (0.5498339973)(1 - 0.5498339973)(0.04762712632) = 0.01178850307$$

$$e_{12} = (0.1)(0.1190678158) = 0.01190678158$$

$$\delta_{12} = (0.7109495026)(1 - 0.7109495026)(0.01190678158) = 2.446885169 \times 10^{-3}$$

Weight Updates:

Weights to Y :

$$w_{01} = w_{01} + \alpha \delta x_{w_{01}} = 0.4 + (0.25) (0.1190678158) (0.5498339973) = 0.4163668833$$

$$w_{02} = 0.1 + (0.25) (0.1190678158) (0.7109495026) = 0.1211628011$$

$$w_{03} = -0.2 + (0.25) (0.1190678158) (1) = -0.1702330461$$

Weights to Z_1 :

$$w_{11} = 0.6 + (0.25) (0.01178850307) (0) = 0.6$$

$$w_{12} = -0.1 + (0.25) (0.01178850307) (1) = -0.09705287423$$

$$w_{13} = 0.3 + (0.25) (0.01178850307) (1) = 0.3029471258$$

Weights to Z_2 :

$$w_{21} = 0.4 + (0.25) (2.446885169 \times 10^{-3}) (1) = 0.4006117213$$

$$w_{22} = -0.3 + (0.25) (2.446885169 \times 10^{-3}) (0) = -0.3$$

$$w_{23} = 0.5 + (0.25) (2.446885169 \times 10^{-3}) (1) = 0.5006117213$$

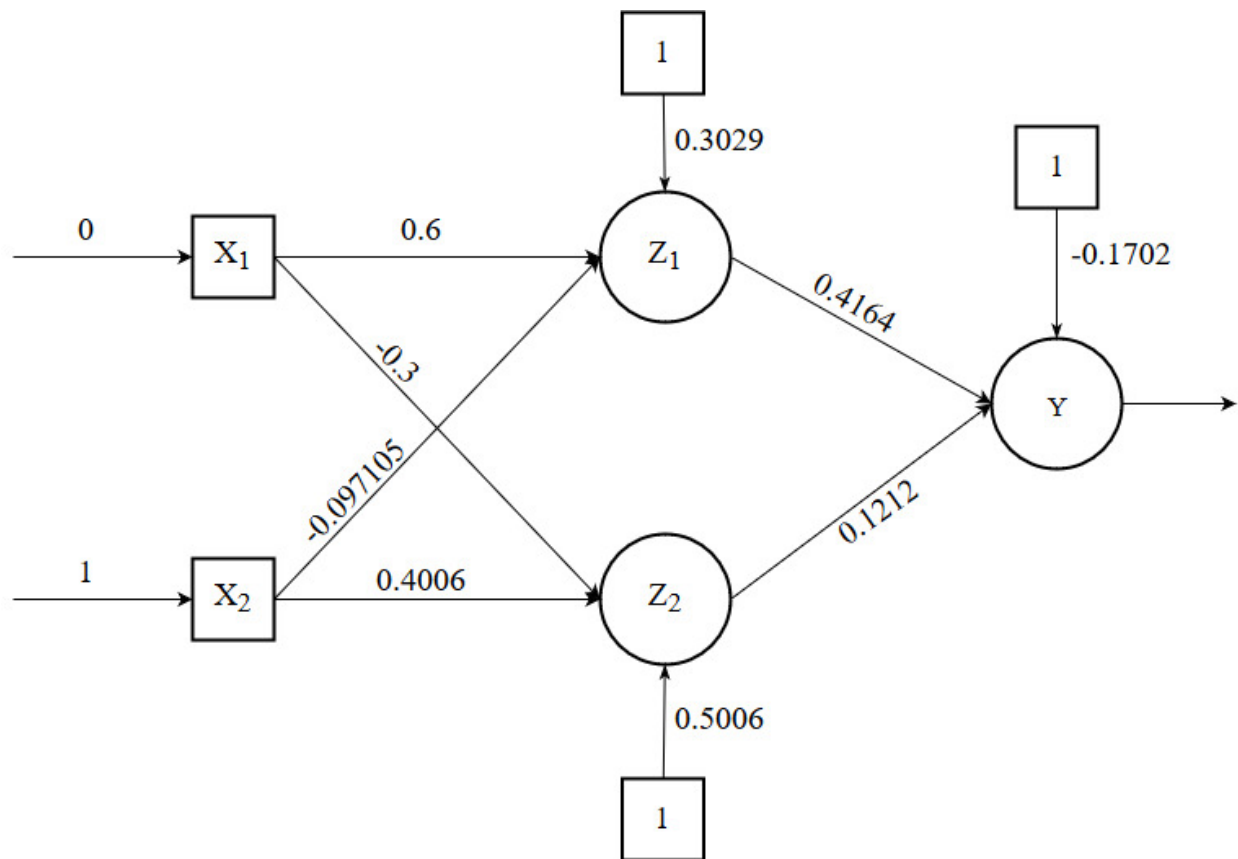


Figure 3: Net After 1 Epoch of Training